



# Simplest Shortest Path First for Provisioning Optical Circuits in Dense Mesh Network Configurations

## Abstract

A method for determining the shortest simplest path in a optical network with mixed DWDM transmission characteristics, mixed switching methodologies (i.e. micro mirrors, bubbles, Electronic TDM, Electronic cross bar, optical signal regeneration, and DWDM wavelength translation using optical devices). Disclosed in the invention is: a.) a multi-layered network path determination method that resolves over-constrained routing requirements, b.) an application of A that resolves routing constraints described for the optical networking environment, c.) A Dense Mesh simplification method that radically reduces the computation and processing power to find the best approximate path through the network, d.) A caching strategy to cache approximate paths rather than exact paths and to age out cache entries just before they become incorrect e.) A method of calculating multiple metrics and checking them against routing requirements during the path determination process rather than afterwards as is done usually f.) A method to turn an approximate path into an exact path that enforces simplest shortest path first and keys cache age out, g.) A method of filling cache entries that enforces simplest shortest path first

The "Simplest path" has no signal regenerators, wavelength translators, or use of electronic switching. Slightly simpler paths require a minimum number of signal regenerators, wavelength translators, or electronic switching. In general terms it is a path that can be completed at the lowest level possible first and then progressively falls back

to higher and higher levels to complete a path that meets routing requirements. "Simplest Shortest path" indicates that a longer path that is simpler has precedence of a "Shorter path" that has additional resource requirements.

Inventors: Matthews, Wallace E. (Mendon, Mass)

Assignee: Matthews, Wallace E. (Mendon, Mass)

Appl No.:

Filed:

### References Cited

#### U.S. Patent Documents

4201889	06-May-1980	Lawrence et. al.
4565903	21-Jan-1982	Riley
4873517	10-Dec-1989	Baratz et. al.
4979118	18-Dec-1990	Kheradpir
4987536	22-Jan-1991	Humblet
4991204	05-Feb-1991	Yamamoto
5218602	08-Jun-1993	Grant
5233607	03-Aug-1993	Barwig
5317562	31-May-1994	Nardin
5321815	14-Jun-1994	Bartalanzo et.al.
5452295	19-Sep-1995	Natarajan

5463620	31-Oct-1995	Sriram
5519836	21-May-1995	Gawlick et.al.
5521910	28-May-1996	Matthews
5526414	11-Jun-1996	Bedard et.al.
5539815	23-Jul-1996	Samba
5561790	01-Oct-1996	Fusaro
5600638	04-Feb-1997	Bertin et. al.
5600794	04-Feb-1997	Callon
5751706	12-May-1998	Land et. al.
5832069	03-Nov-1998	Waters et. al.
5805593	08-Sep-1998	Busche
5893081	06-Apr-1999	Poppen
5937397	10-Aug-1999	Callaghan
5999517	07-Dec-1999	Konig et. al.
6016306	18-Jan-2000	Le Boudec et. al.
6016485	18-Jan-2000	Amakawa
6084858	04-Jul-2000	Matthews et. al.
6151327	21-Nov-2000	Sofman et. al.
6205154	20-Mar-2001	Schmidt et. al.
6205484	20-Mar-2001	Eriksson

#### Foreign Patent Documents

### Other References

Coral Broadband Enterprise Switch, Product Literature, Coral Network Corp.

Marlborough, MA (1994)

C. J. Wang, E. P. K. Tsang, "Solving Constraint Satisfaction Problems Using Neural Networks", Second International

Conference on Artificial Neural Networks, Nov. 18-20, 1991.

S. Selman, H. Levesque, D. Mitchell, "A New Method for Solving Hard Satisfiability Problems", AAAI-92, Proceedings

Tenth National Conference on Artificial Intelligence, Jul. 12-16, 1992.

Maruyama et al, "Solving Combinatorial Constraint Satisfaction and Optimization Problems using Sufficient Conditions for

Constraint Violation", Proc Int'l Symposium on AI, Nov. 13-15 1991, pp. 269-275.

Smith et al, "Combining Constraint Satisfaction and Local Improvement Algorithm to Construct Anaesthetists Rates" Proc

8th Conf on AI for Applications, Mar. 2-6, 1992, pp.106-112.

Wang et al, "Solving Constraint Satisfaction Problems Using Neural Networks" and Int'l Conf on Neural Networks, Nov.

18-20, 1991.

Mital et al, "Dynamic Constraint Satisfaction Problems", Proc 8th Nat'l Conference on AI, vol. 1 pp. 25-32, Jul. 29-Aug. 3

1990.

**This Patent was developed independently of any Federally sponsored research. It is solely the work of Wallace Matthews of 41 Kinsley Lane, Mendon, Mass. Currently self employed and an independent inventor.**

An example software listing is being supplied on CD Roms. The CDRom is CD-R machine Format produced on an IBM Compatible PC running Windows-2000 using the MicroSoft Windows NT file System formats. All files are Ascii Text files and viewable via any Unix or Windows compatible Text Editor. The files are Python Source code files with a ".py" extension. Python is the chosen language because it is very "readable" yet compact. For those not familiar with Python, it has many of the characteristics of Java, yet is easier for a novice programmer to learn and to understand.

File Names	File Size in Bytes	Original Creation Date
Route_1.py	15,000	6/17/2001 8:08PM
Route_common.py	3,000	6/17/2001 7:56PM
Policy.py	1,000	5/20/2001 9:59PM
Path.py	7,000	6/17/2001 2:37PM

Node.py	23,000	6/17/2001 7:36PM
Metric.py	16,000	6/2/2001 8:44PM
Link.py	24,000	6/17/2001 8:42PM
Cache.py	50,000	6/17/2001 8:29PM